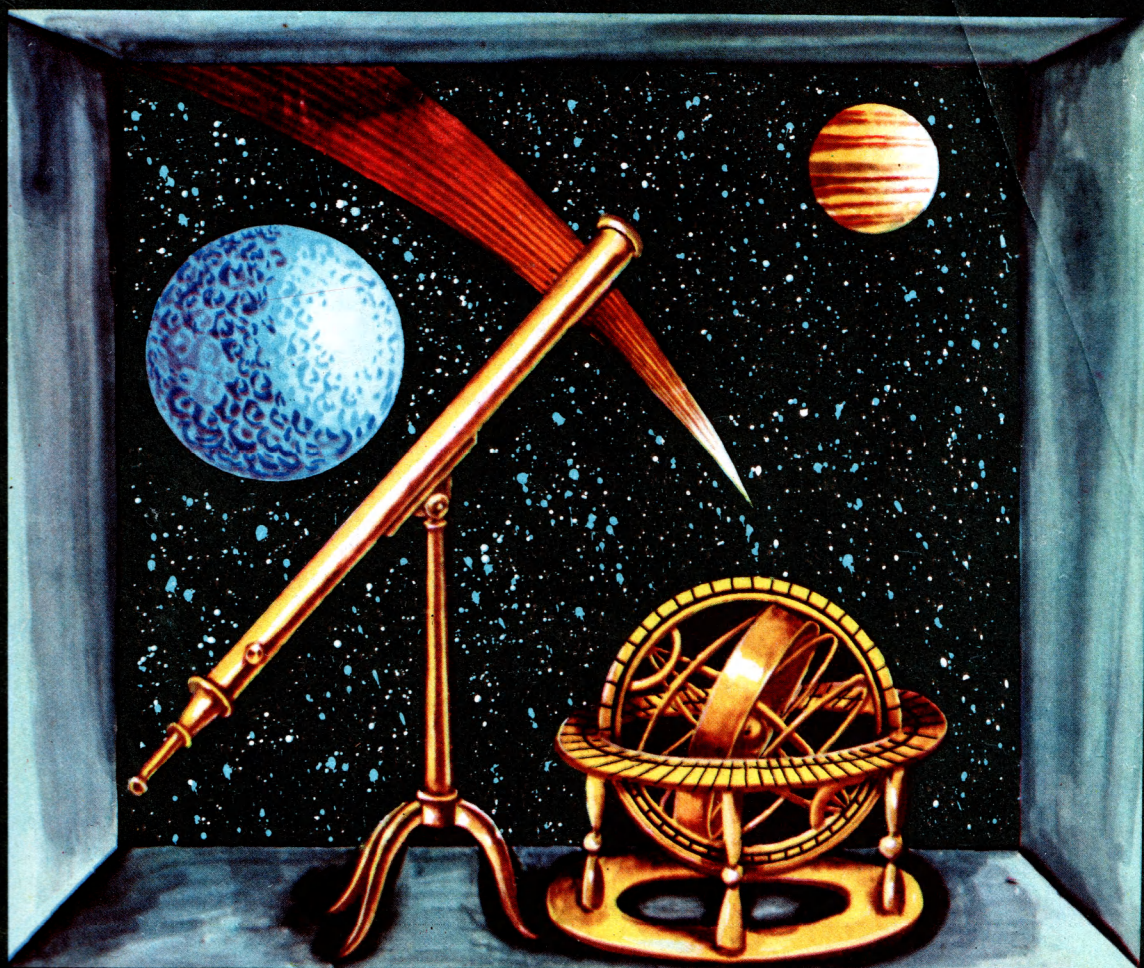


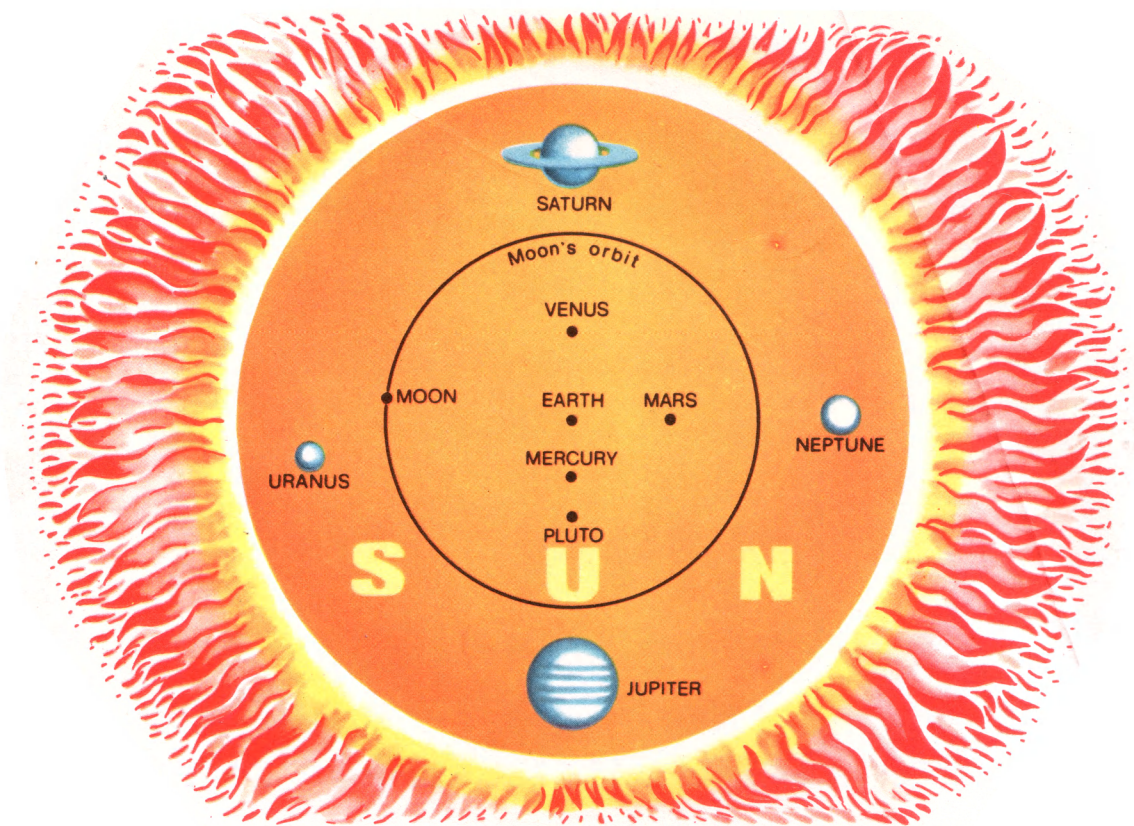
FELIX KRIVIN



GREATGRANDMOTHER UNIVERSE

MALYSH PUBLISHERS



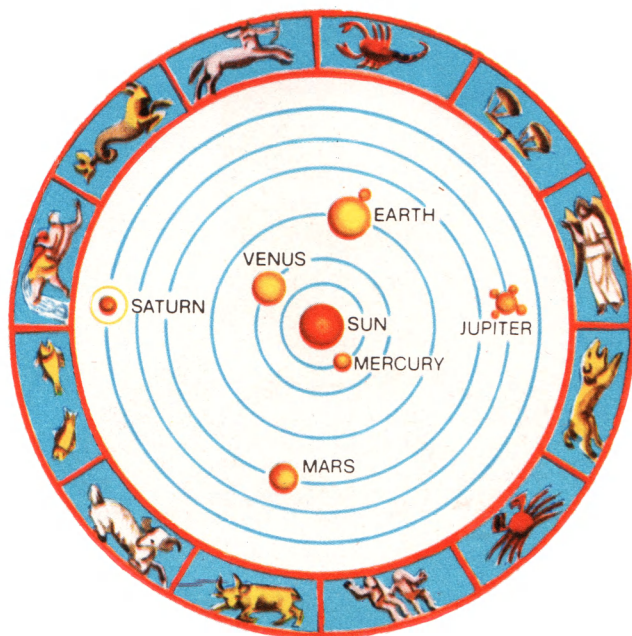


WHAT DO WE KNOW ABOUT OUR GREATGRANDMOTHER?

Our Earth is very big, but Space is bigger than the Earth. It holds the Sun, which is bigger than the Earth, the stars, which are bigger than the Earth, and our galaxy, which contains the Earth, the Sun, and so many stars that you could not count them in all your life.



This is how the contemporaries of Copernicus understood the place of the Earth in the Universe



And this is the way Copernicus saw it

Do you see how big Space is? But the biggest of all is our Universe.

Everything that exists in the world, Space and galaxies included, are in our Universe. That is our Universe.

When you walk along a street, you are also walking in the Universe. There is no street outside the Universe.

So, you see, the Universe is the biggest thing in the world. There is nothing bigger.

It is also the oldest thing in the world.

There is simply nothing older than the Universe.

Even our galaxy, which has some very old stars, is really a girl when compared to the Universe. Well, maybe not a girl. If we speak of the Earth as our mother, our galaxy is our grandmother. And our Universe is our great-grandmother.

All greatgrandmothers are very old, and the Uni-

verse is the oldest of them all, so to say. It has seen a lot in its long life.

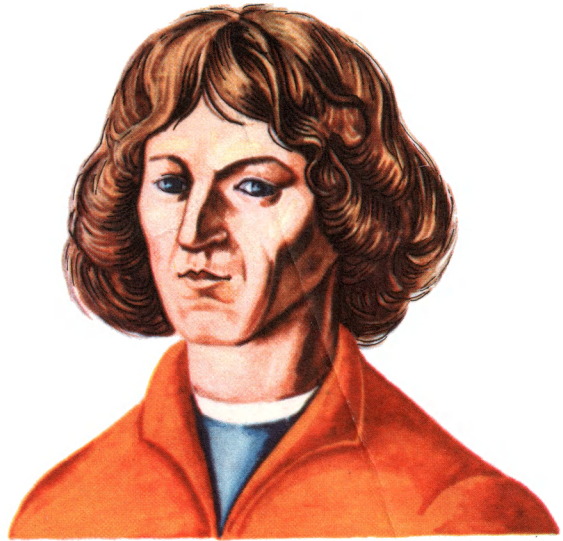
Just imagine what it could tell us!

But the Universe will not tell us anything unless we know how to ask it. Scientists know best how to do this. They ask the Universe questions and then tell other people the answers.

Maybe you will learn to speak to the Universe, ask it questions, and get exact answers. Then you will be called a scientist and will be asked to find out something about our Universe that nobody knew before you.

You see what an important greatgrandmother we all have. To speak to her you yourself must know a lot.

And the more you know, the more you will be able to find out. Then everybody will want to talk to you. Maybe even our greatgrandmother.



The great sixteenth-century Polish astronomer Copernicus, who discovered that the Earth revolves around the Sun



The great seventeenth-century Italian astronomer Galileo, who discovered that the Earth not only revolves around the Sun but also rotates on its axis



WHAT IS OUR GALAXY?

Our Universe is full of milk. Do not be surprised. There are many galaxies in the Universe, and all are “rivers of milk”. The ancient Greeks named them in this way. “Gala” in Greek means “milk”. The biggest collection of stars seen from the Earth is called the Milky Way.

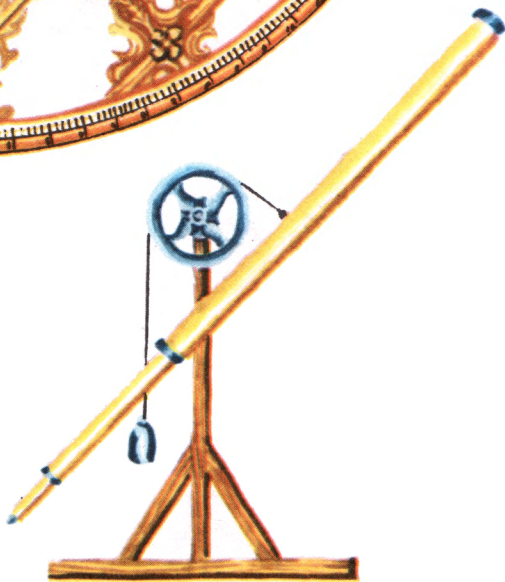
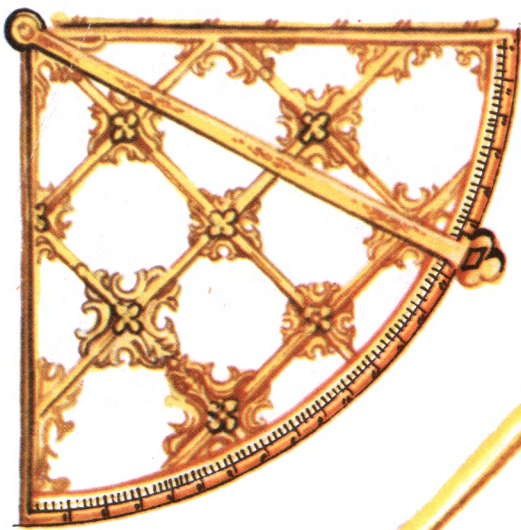
But galaxies are more like islands than rivers. They are islands of stars in the boundless ocean of the Universe. Or even better, they are small oases in the boundless desert of the Universe. Although the galaxies are not small but very big, even the biggest oasis will seem small in a desert that has no end to it.

Our Universe is a boundless desert, and the galaxies are small oases. But even the fastest runner in the world, a beam of light, needs millions of years, even a thousand million years, to cross such an oasis.

Do you know what a thousand million is? It would take you at least twenty years to simply count to a thousand million, and that is without taking time off for sleep or eating. And to count the kilometers that light travels in an hour you would again need twenty years, because light travels a thousand million kilometers in an hour. It takes light a thousand million years to race through a galaxy, going at speed of one thousand million kilometers an hour.

So you see our galaxy is nothing more than a little oasis in the Universe. Milk has nothing to do with it of course. The Milky Way is called so because from afar it resembles spilled milk. Names are often given because of outward resemblance. For instance, the Great Bear and

*This is how people in ancient times pictured
the stars in the sky*



Little Bear constellations (constellations are star patterns as seen from the Earth) were called so by the Greeks, who thought they looked like bears. The Lion constellation looked like a lion, and the Hare constellation like a hare.

The two Bears, the Lion, the Hare, and also the Fox, the Giraffe, the Swan, and the Eagle are all named after living creatures because these creatures had names, and the constellations did not.

This is the way the Universe got filled with milk—simply because it contains many galaxies, or “rivers of milk” as people called them a long time ago. You must learn to understand the difference between the name and the actual thing. Otherwise you will be going to the stars for milk, or when you go to the store for milk, you will think you are going to the stars.

Scientific instruments with which the people of the Earth learned about the Universe (astrolabe, quadrant, and telescope)





WHY CANNOT WE WALK TO THE PLACE WHERE THE SKY AND EARTH MEET?

Did you ever try to walk to the place where the sky and the Earth meet? If you did, you know that this is impossible.

When we go into the fields, where we can see a great distance, we see far, far away a thin line where the Earth meets the sky. Now if we start walking towards the line to have a good look at it, it moves farther and farther away. Why does it move away from us? We only want to have a look at it.

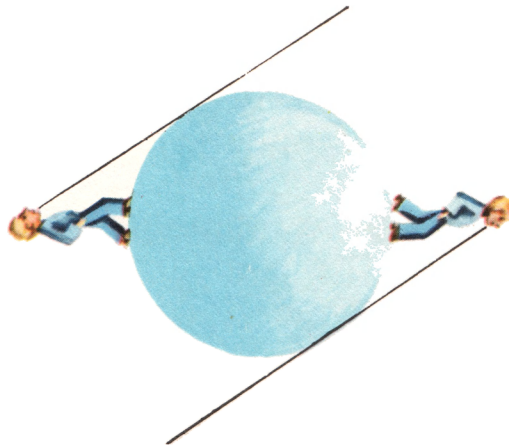
But it does not want us to come close. It is afraid of us. We take a step, and it moves away a step. We take another step, and it moves again. And if we try to walk away from it, it follows us. It will not fall behind even if we travel in the fastest car, but it will always keep its distance from us.

The distance will always be the same. We can never reach the line. We can walk toward it all our lives and never reach it.

But do not lose hope. When this strange line withdraws, it opens up new lands to us. We discover something we did not know before.

Frankly speaking, there is no line at all. We only think there is because the Earth is round and it seems to meet the sky. But isn't it a good thing that the two at least seem to meet?

The Earth would like to ask the sky about other worlds, and the sky would like to see how our Earth lives and maybe learn something from it.



WHY DOES NOT THE SUN DROWN IN THE SEA?

Have you ever seen the Sun bathe in the sea? It approaches very slowly at the point where sea and sky meet and hesitantly enters the water, almost as if it is afraid the water is cold. And all the time it grows redder, as though ashamed that it cannot dive into the water as divers do who are not afraid of cold water.

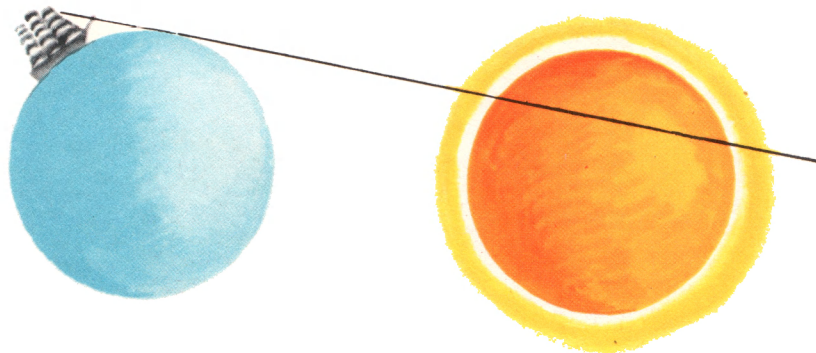
But finally the Sun is in the water. At once there is a great commotion. A rescue team of stars with the Moon in the lead as chief rescuer appears. The stars use their flashlights and try to find the Sun in the sea, but in vain—the Sun has sunk too deep. Meanwhile the wind howls the alarm: “The Sun has drowned!”

The rescue team labors all night long. Then it turns off its lights one by one, losing all hope of helping the poor Sun.

When the last star has winked and disappeared from the sky, the Sun suddenly appears safe and sound, not in the place where it drowned but on the opposite side of the horizon.

What a relief! But what a surprise, too! In the evening the Sun drowned and in the morning it appeared, just as if nothing had happened. But maybe it did not drown after all? Everybody thought it did, but instead it simply hid itself so nobody could see it.

Frankly speaking, the Sun did not hide itself at all.





Simply the Earth, which is always turning, showed the Sun its other side. First it showed our side and then the other side. And when it showed the other side, we could not see the Sun.

You must never panic.

What must you do not to panic?

You must know that the Earth moves around the Sun and at the same time turns around and around like a spinning top. Not only night replaces day, but day replaces night.

The more you know, the less apt you are to panic. Then you will simply watch the Sun set in the sea without calling for help and admire the magnificent sunset.

CAN ONE LIVE ON THE SUN?

There can be no life on Earth without the Sun. What about life on the Sun? Is there any?

No, there is no life on the Sun, although without the Sun there would be no life on Earth.

Strange, isn't it? The Sun teaches others how to live but does not know how to live itself.

This sometimes happens, you know. But the Sun not only teaches the Earth how to live. It also gives the Earth its warmth. When you give others your warmth, you are helping them to live.

The whole trouble is that the Sun has too much warmth. It has so much that it must give it away as fast as possible and cannot use any for itself. A furnace gives off a lot of heat, but can you think of anybody living in a

furnace? He would burn up. The Sun is simply a very big furnace.

Even stones, which on Earth can stand any conditions, would melt and turn into gas on the Sun. Even the sunbeams that you like to reflect from a mirror want to get away from the Sun. They are born on the Sun but they run away to the Earth so as to jump about between houses, splash in ponds, and bounce off trees. Well, if even sunbeams cannot live on the Sun, then what can?

No life is possible on the Sun, but without the Sun there would be no life on the Earth.

If the Sun did not give away its warmth, there would be no use in all the warmth. When you have something and do not share it with anybody, you are not happy and no one else gets any good from it.

But if you share your warmth, everybody is happy around you. If someone is cold, he feels warmer, and if someone feels bad, he begins to feel better. Sunbeams run from you to far-off places to tell everybody about you and give others some of your warmth and light.



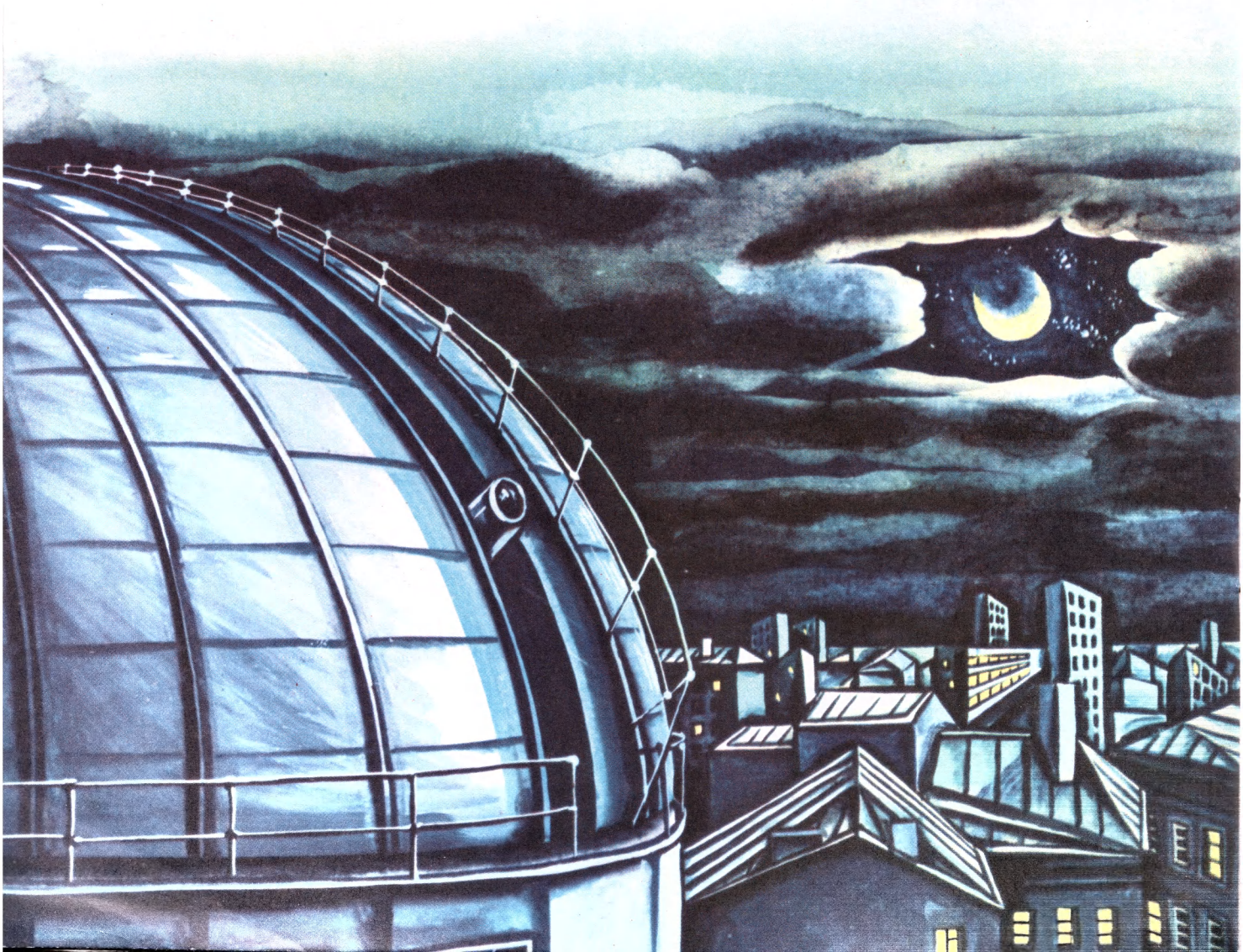
This is how our ancient ancestors imagined the inhabitants of the Sun

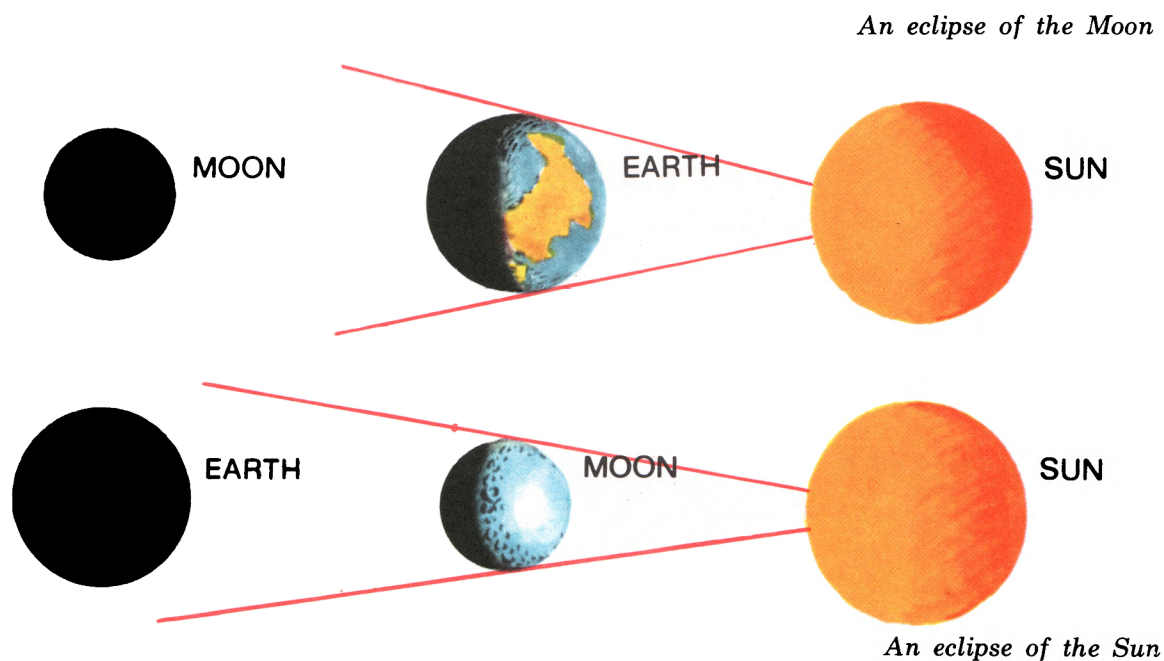
WHY DOES THE MOON SHINE AT NIGHT?

Do you know that the Moon has no light of its own to give off? Light comes from it to us, but this is not its own light.

You could say that a mirror gives off light when it reflects the light of an electric bulb. But if you switch off the bulb, the mirror will immediately stop giving off light. It cannot shine without a burning bulb. In the same way the Moon cannot shine without the Sun.

But you will say that the Moon shines at night when there is no Sun.





Now that is not true that there is no Sun at night. The Sun shines all the time, even at night. It may be dark where we are, but it is day on the other side of the Earth. Simply we do not see the Sun.

But the Moon sees it well.

We live on the Earth, and for us the Earth is so big that it can completely block the Sun from us when we are on the “dark” side. But the Moon is far from the Earth and travels around it in circles. This is why it is seldom blocked from the Sun by the Earth. The Moon reflects the light of the Sun and pretends this is its own light even when the Sun is not seen by us directly.

What happens when the Sun, the Moon, and the Earth lie along one line, and the Earth is between the other two? How does the Moon shine when it is blocked from the Sun by the Earth?

It does not shine at all, and this is known as an eclipse of the Moon.

So, you see, the Moon is not a source of light. It only reflects or steals someone else's light.

Now how does the Moon shine when it is between the Sun and the Earth? It not only does not reflect any light, but it even blocks the Sun from us. Scientists call this an eclipse of the Sun because the Moon passes in front of the Sun. Part of the Earth's surface is then covered by darkness. Not a very good way for the Moon to shine, is it?

But we have already discovered that the Moon is not a source of light. It simply steals the light of the Sun.

Do you see now why the Moon appears at night? It has to wait until the Sun is on the other side of the Earth so that nobody can see the Moon stealing the Sun's light and no one can compare the reflected light with the real light of the Sun.

But eclipses betray the Moon!

That is why astronomers like to study heavenly bodies during eclipses. When an eclipse starts, they can see which planets and stars in the sky can produce light and which use the light of others.

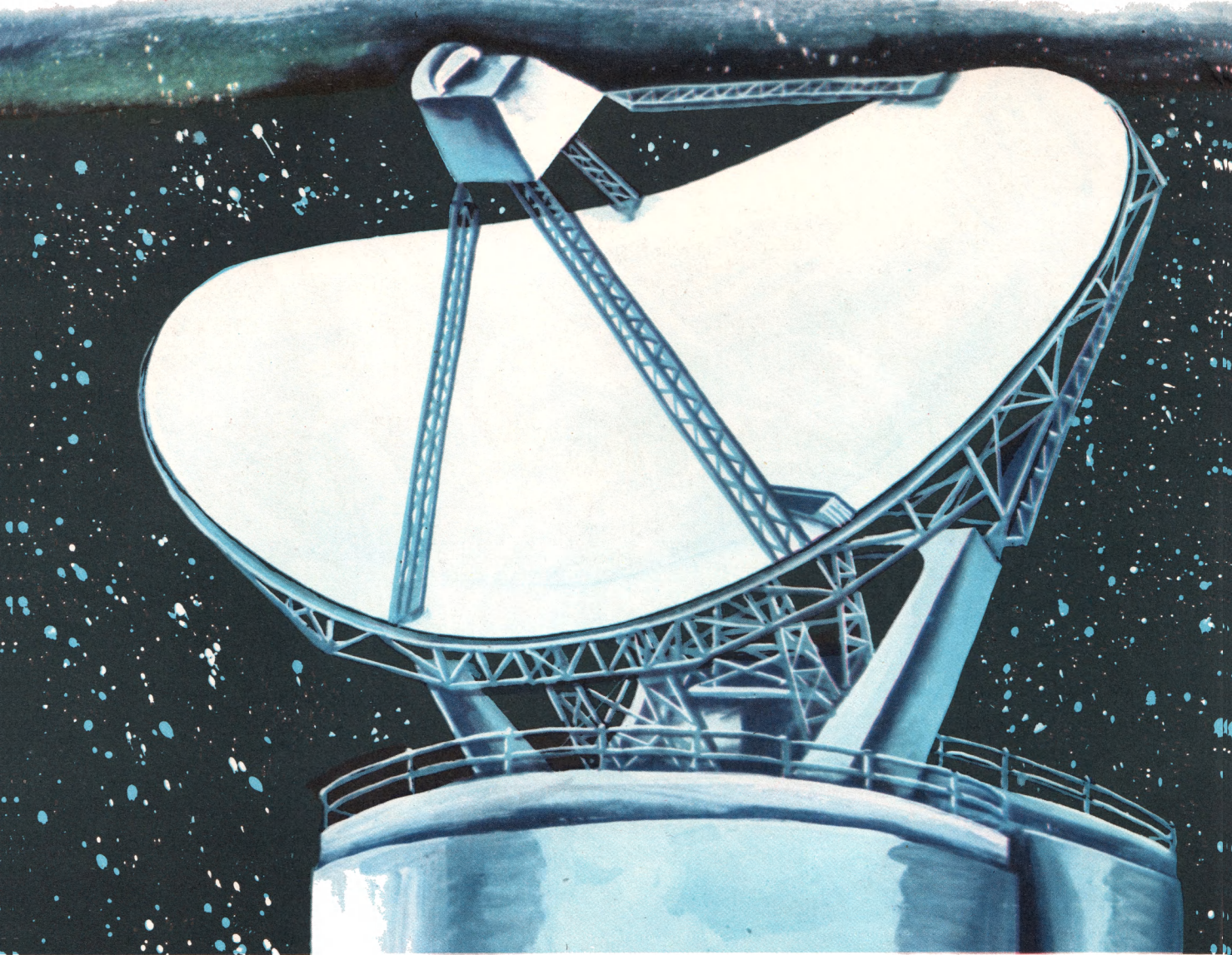
HOW MANY STARS ARE THERE IN THE SKY?

There are so many stars in the sky that it is impossible to count them. Yet the stars have been counted. That is, those that can be seen from the Earth have been counted.

A great many stars cannot be seen from the Earth.

This is an optical telescope. Astronomers use it to study the stars





And this is a radio telescope

And the Earth knows nothing about most of them. But these do not stop being stars because of this, do they? The stars, both seen and not seen, are still real sources of light.

Every star can be seen somewhere. In far-away worlds stars that cannot be seen from the Earth can yet be seen by the inhabitants of those worlds. When you see a star, remember about the other stars which do not shine for us but can be seen somewhere else.

WHY ARE THE STARS SO SMALL?

Have you ever seen a man on top of a hoisting crane? From the ground he looks very small. But he is not small. He cannot be small. Just see what a tall house he is building.

At a distance everything seems small. Even the tallest building appears small when seen from a distance. Even the Earth seems small when looked at from Space.

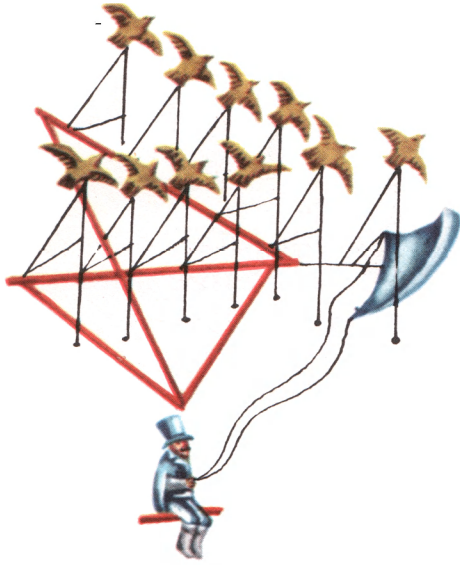
What about the Sun? It looks no larger than a ball but, in fact, it is much larger than the Earth.

Some of the stars are many times bigger than the Sun, but to us they look tiny because they are much farther from us than the Sun.

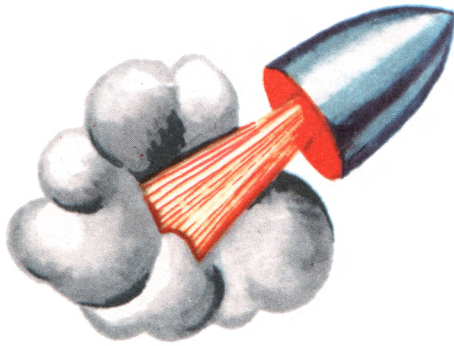
The actual size of anything can be seen when you are close to it. To size up a person you have to take a close look at him. But if you look down on a person or view him from afar, you will never know his real size.

WHERE DO THE STARS GO IN THE DAY?

When the Sun appears in the sky, it is always amazed that no stars are about. At night, when there is no Sun, all the stars are up there, in the sky. Where do they all disappear to in the daytime? This is really an intriguing question, isn't it? Every morning, before rising, the Sun peeps out from behind a forest or a mountain and tries to see where the stars are going. But just as soon as it does this, the stars vanish from the sky.

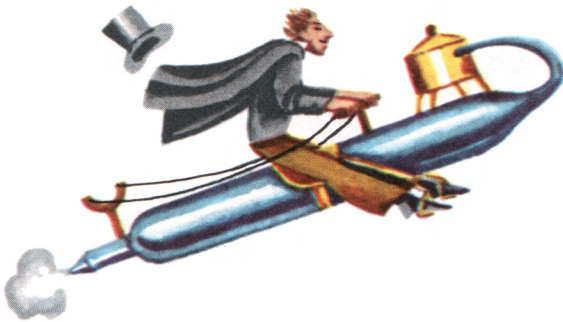


Then the Sun rises high so as to light up everything, hoping to find at least one tiny star that was not able to hide fast enough. But it cannot find any star, even the smallest. Why? Well, because a light is always best seen in the dark. In daylight this light gets lost, it tries to keep out of sight, almost as if it is ashamed of being so weak.



The same happens to the stars. Even the brightest cannot compete with the Sun's light in our sky, although somewhere it is brighter than a thousand Suns.

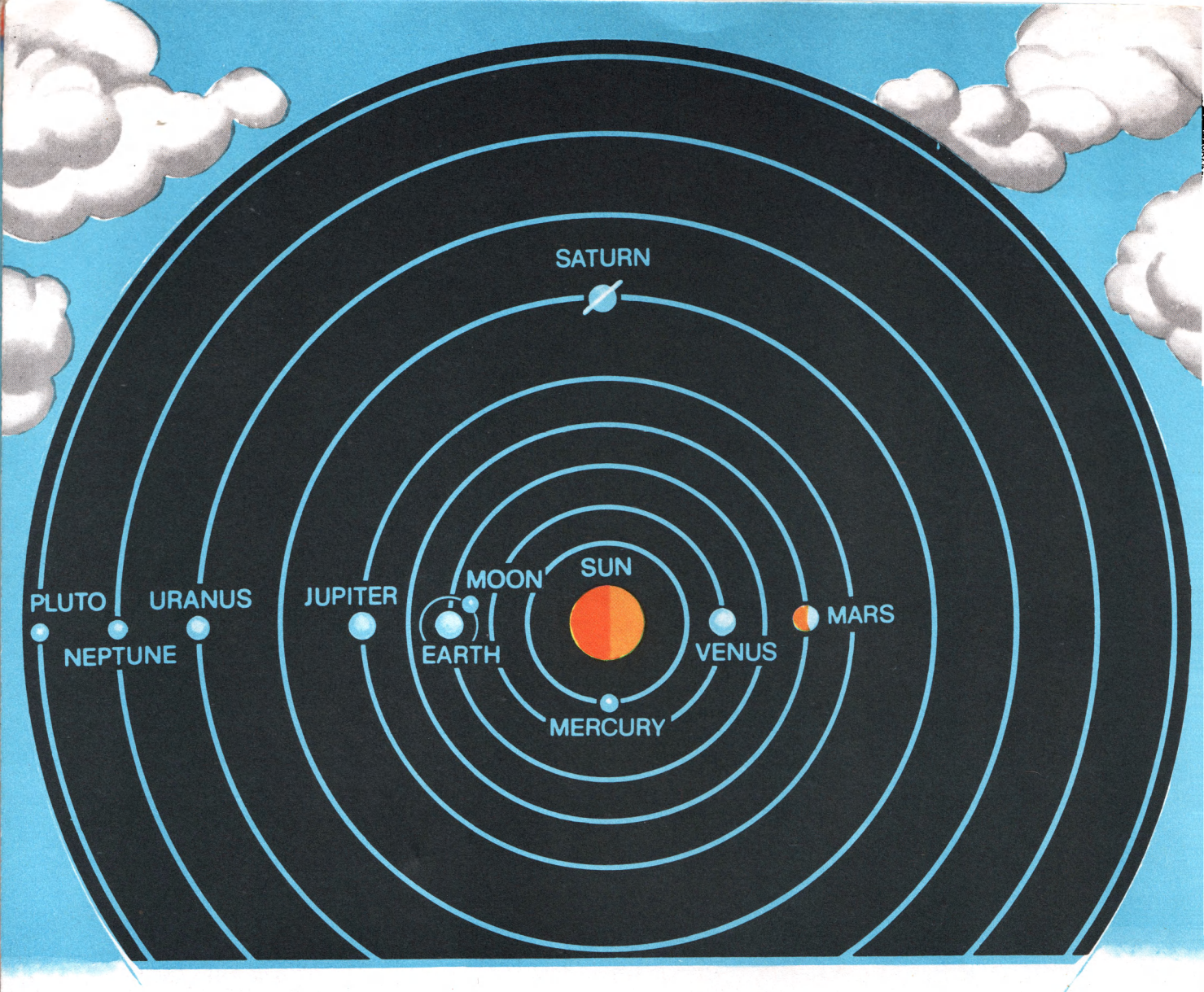
It is very important to shine where your light is needed, where nobody can do without it.



A star becomes a sun only in its own sky. There it is a real sun, of which other stars are afraid. Even the most starlit night is only a night. It will not turn into day until the Sun appears again.

*See how differently people at different times
imagined travel to the stars*





CAN A SATELLITE BECOME A PLANET?

All planets are satellites, but all satellites are not planets.

You may think that size determines what is a planet and what is a satellite. Most planets are bigger than the satellites, but not all.

For instance, Ganymede, the main satellite of Jupiter, is bigger than Mercury. But Ganymede is only a satellite, while Mercury is a planet. It is a satellite of the Sun but still a planet. How can Ganymede be a planet if it is a satellite of a planet, the planet Jupiter?

Planets are always satellites of a star, if of course they are big enough to be called planets. If they are too small to be in the family of planets, they are called asteroids, which means "starlike".

A satellite of a planet will never be called an asteroid because it travels around a planet, not around a star. This is why an asteroid is also called starlike, because it is a small satellite of a star.

It is not important whether something is a satellite or not. It is important whose satellite it is: of a star, a planet, or of another satellite. The rule in our Universe is: if you tell me whose satellite you are, I will tell you who you are.

WHO WALKS ALONG THE MILKY WAY?

Do you know that you and I are walking along the Milky Way?

Look up at the night sky, and you will see the Milky Way. This is the path we are following. Not only you and I, but everywhere people are walking along this path. No matter where they live or where they go, they walk along the Milky Way.

All trains, too, travel along the Milky Way. So do all ships and all airplanes.

See what a wide Milky Way it is. It seems small only from the Earth.

You may not believe it, but the Earth too moves along the Milky Way. And so do all the other planets. Even the Sun, around which the Earth and the other planets travel, even the Sun moves along this path. Among the thousands of millions of stars in the Milky Way the Sun is just one small star.

With our Sun we are only at the beginning of our trip along the Milky Way. We have a long, long way to go, a long, long way to fly, together with the thousands of millions of other stars that are traveling along the Milky Way and lighting each other's path.

Do you see the Milky Way glitter in the sky? Those are stars showing us the way. We are following the star trek.

You will never forget this, will you?

Wherever you go, on land, sea, or in the air, remember that you are moving along the star trek. You are moving along a path that leads to the stars.





Felix Krivin
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